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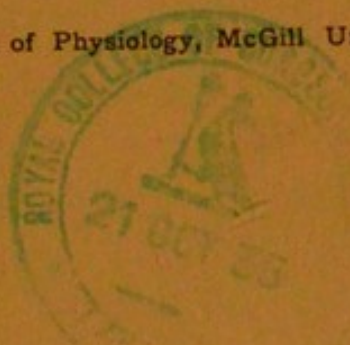
THE PSYCHIC DEVELOPMENT OF
YOUNG ANIMALS

AND ITS PHYSICAL (SOMATIC) CORRELATION

WITH SPECIAL REFERENCE TO THE BRAIN

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II.—*The Psychic Development of Young Animals and its Physical (Somatic) Correlation with Special Reference to the Brain.*

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Professor of Physiology in McGill University, Montreal.

(Read May 20, 1896.)

It seemed to me important that psychic and somatic development should be traced contemporaneously, so closely are they related, and in the six papers printed in these Transactions for 1894 and 1895, an attempt was made to realize, to some extent, this ideal, but as my researches on the brain were not completed till after the publication of these investigations I thought it better not to attempt to utilize them at the time. The investigation bearing on the functional development of the cerebral cortex, with special regard to the motor centres, extends to all the groups of animals falling under my studies in psychic development, and is presented in the present volume of the Transactions, so that it is now possible to deal with the most important part of the somatic correlation, viz., with the brain. Naturally I shall draw chiefly from the latter paper and from those on psychic development for the facts, etc., on which reliance will be placed in attempting further progress in regard to a more complete correlation of the somatic with the psychic.

No attempt will be made in this paper to discuss somatic correlation in general as that subject has been treated in the papers previously published in these Transactions.

It would be quite correct to speak of the relations as anatomical and physiological correlation, but as movements are so bound up with the psychic developments of animals I think it will be more instructive to consider the subject from this point of view, and in doing so the psychic will be first taken into account.

I.—THE DOG.

As soon as a puppy is born, it is capable of cries, crawling and sucking, and if we except those concerned with the vital or vegetative functions, these about cover all its possible movements. Up to the period when the eyes open, there are no new movements. Every one of these can be produced experimentally as reflexes, and the question is, are they naturally of this character. They improve from day to day, but that is a feature of all reflexes, even the best organized (as swallowing) though it has hardly been adequately recognized.

As pointed out in my paper on the functional development of the cerebral cortex, the latter is absolutely inexcitable at birth and for a good many days after, indeed not till about the period of the opening of the eyes, and as I find the white matter also inexcitable at birth there seems to be no other view possible of these movements than that they are reflex and that when the brain is called into action parts lower than the cortex or even the underlying medulla in the youngest puppies must function.

Nevertheless the animal at this period is progressing, for the improvement of these reflexes implies the more perfect organization of a neuromuscular mechanism which is probably availed of later in all voluntary movements.

In adult life our own movements are often carried out with a perfection in proportion to the degree in which they are reflex or according to the facility with which higher centres use lower ones and thus economise psychic energy.

But even so early as the twelfth to the fifteenth day new movements are possible. The eyes have opened, the ears also, and both eyes and ears move, rather reflexly at first beyond doubt, but very soon the puppy moves both eyes and ears voluntarily at times, and still later he fixes the eyes, which is clearly a voluntary act.

It is obvious that there is now an approach to walking (instead of crawling). There are tail movements by the seventeenth day, and the scratching reflex is excitable. The tail movements are at this period almost certainly reflex. Voluntary movements of the tail do not seem to be possible till a good deal later, which corresponds with the well-established fact that the cortical centre for tail movements is not developed till comparatively late.

The barking of the nineteenth day was probably a reflex, much simpler than such as results later. At this stage puppies often bark in their sleep, not a common occurrence with mature dogs, though it does take place in dreaming. By the twenty-third day the puppies stand with the paws on the edges of the boards constituting the walls of their pen. This act may be reflex at times possibly, but on other occasions it is clearly voluntary, and, as they try to get out, we are left in no doubt that they are capable of willed movements, so that by this time, and probably before, there are undoubted voluntary movements. Corresponding with this advance, I have found before the twentieth day very distinct cortical localization for the limbs, head and face.

Later than this improvement in reflexes is noticeable, but still more the rapid development of older and the introduction of new voluntary movements, involving more and more complex co-ordinations, and from the psychic aspect the manifest possession of the power to use the machinery of the nervous system and muscles in a way that implies the existence of a growing intelligence and will; and the careful observation

of a litter of puppies, as shown in my paper on the dog (these Transactions, 1894), will impress both the physiologist and the psychologist with the rapidly increasing complexity of the life of a young dog, a complexity in which reflex and voluntary movements, instincts, intelligence, emotions and will blend in varying but ever augmenting degrees of intricacy, with all of which the rapidly developing cortex is correlated, and, as I have endeavoured to show in earlier papers, there is a large amount of somatic correlation over and above that of the brain, which is constant as to period of development, but with variations for individuals and breeds.

The rapidity of psychic development of a terrier as compared with a St. Bernard is very striking, even within the first six weeks of life, but persists to maturity; and this, I have found, is correlated with a decidedly slower functional development of the cerebral cortex in the St. Bernard; the difference in the motor co-ordinations in the latter and the terrier is so striking within the first six or eight weeks of life as to be ludicrous.

II.—THE CAT. THE DOG AND THE CAT COMPARED.

Nearly all that has been said of the reflexes of the dog applies, of course, to the cat. There are, however, as would be expected, some that are peculiar to the cat, as hissing, which manifests itself at a surprisingly early date in the kitten, long before the eyes open.

As pointed out in my paper on the cat, there is a general and more speedy development in this animal as compared with the dog, and this holds even for reflexes, *i. e.*, they reach perfection more rapidly; in fact, speaking generally, the cat develops faster than even the smaller varieties of dogs as terriers.

By the sixteenth day the kitten specially observed by me licked its paw. This, under the circumstances, can scarcely be regarded as a pure reflex; certainly dogs do nothing comparable to this at so early a date. It also scratched its head with the hind leg on the sixteenth day. Whether this be regarded as voluntary or reflex, it indicates that the cat is in advance of the dog.

Nothing could better demonstrate the more rapid psychic development of the cat than the earlier date at which it steadily follows a moving object with the eyes or fixes them for some time on a stationary one. In fact, the kitten does this at a time when it is still doubtful if the puppy sees objects as such distinctly.

On the eighteenth day the kitten climbed up the side of its box and tried to get out. Nothing comparable to this occurs in the puppy till a good deal later. It may be said that the history of the cat during the first six weeks of its life contrasts strongly with that of the dog as regards the more rapid development of reflex movements, the earlier appearance

of voluntary movements and the speedier perfection attained by each, together with the more ready and complete utilization of experience, the early intelligence, the strength of the will and the power of attention.

All this is correlated with that earlier development of the cerebral cortex which I have shown occurs in the cat, and there is probably a greater difference than can be made manifest by our crude methods of experiment.

A very marked feature in the psychic development of the cat is the early appearance of the play instinct¹ and the perfection of the fore-limb in carrying out the movements necessary for its manifestations. The cat has incomparably better use of the fore-limb at an early date. I have recorded observations on play (with use of the paws), as early as the twenty-second day, and, as is well known, the kitten and the older cat have a variety and perfection of movement of the fore-limbs never acquired by the dog. This is distinctly correlated with brain development, for, as I have pointed out, movements of the fore-limb are in the cat the first that can be induced by electrical excitation of the cortex, and to this observation my experience leads me to believe there are practically no exceptions, while the case is very different for the dog. Some investigators have expressed the opinion that the fore-limb is also the first to respond in the dog, but this does not accord entirely with my experience. It has occasionally been so in the puppies on which I experimented, but in the large majority the hind-leg responded first. Mongrels and pure-bred animals of different varieties were used. I do not, therefore, believe that the statement that the fore-leg in the dog is always the first to respond to electrical excitation can any longer be maintained as a sound generalization; but it may be as I have suggested in my paper on the brain that the truth is that sometimes the one and sometimes the other limb is the first to react, and that large allowance must be made in any general statement for individual and breed differences.

III.—THE RABBIT.

Such a creature as the rabbit contrasts in the most marked manner with the dog and the cat.

A rabbit to the last is much more a creature of instincts and reflexes pure and simple with relatively but little intelligence, all of which is in harmony with its simple modes of existence. Its food is in the wild state usually abundant, and as its escape from enemies is accomplished by swiftness in flight or by taking refuge in its burrow, there is little in its environment to develop intelligence. With the carnivora it is quite otherwise. They obtain their food by cunning, stealth, stratagem—it may be concerted action, as in the case of wolves, hyænas, wild dogs, etc.

¹The whole subject of play in animals is exhaustively treated by Dr. Karl Groos in his "Die Spiele der Thiere." Gustav Fischer, Jena, 1896.

The ease with which reflex actions are excited on the very first day of existence in the rabbit is striking and remains a very distinct peculiarity; and on the same day the paws were used to wipe away an offending substance placed in the mouth. On the third day scratching of a surface was observed, an act which has no small part in the burrowing life of rabbits. By the fifteenth day they eat, and from this date onwards they progress rapidly to perfection of reflex and voluntary action. The early and rapid development of chewing or eating movements soon associated with the use of the paws to hold food contrasts in the most decided way with the slowness of the development of good eating movements in the dog and still more so in the cat. The rabbit's cortex is inexcitable till about the period of the opening of the eyes on the ninth to the twelfth day, and the movements in which the head and face parts are concerned can be induced by electrical stimulation about this time. It is to be specially noted that these movements can be produced in the rabbit experimentally almost as soon as those of the fore-limb, in fact, I question whether in some cases at least they are not excitable earlier and with greater facility, *i. e.*, with a weaker current. With the hind-legs the case is altogether different; in fact, my investigations would lead me to infer that the hind-legs are never related to the cortex in the same way as the fore-limbs. In no case have I been able to establish to my satisfaction the existence of a cortical centre for the hind-legs of the same nature (to put the matter cautiously) as those for the fore-limbs, head, face, etc. The relation between the early and all but simultaneous development of the cortical centre for the fore-limbs and head (and face) parts and the physiological and psychic manifestations of the young rabbit afford one of the most beautiful and striking illustrations of correlation known to me.

IV.—THE CAVY OR GUINEA-PIG.

The cavy comes into the world able to take care of itself. It can in a few hours, if not at once, run about quite well, eat, etc. It is at the outset as far on in the path of development as a rabbit some days after its eyes open, though in the end there is little difference between these two rodents physically or otherwise.

Corresponding with this advanced physiological and psychic development, the cortex is, as I have shown, excitable at or soon after birth, so that here again there is rendered evident by experiment a close correlation of the kind considered throughout this paper.

V.—BIRDS.

One learns how large a proportion of the possibilities, physiological if not psychic, in the pigeon are not dependent on the cerebral cortex, or even the entire cerebrum, by ablation of the latter. Movements, though

not spontaneous, are nearly as perfect afterwards as before, and much light is thrown on the nature of reflexes.

I have, after careful investigation, been unable to find any motor cortical centres whatever. The whole cerebral cortex appears to be absolutely inexcitable, except, perhaps, as concerns certain eye movements, and as for these a strong stimulus is required, it is doubtful if they are of cortical origin in the usual sense of the term.

Nevertheless, unless we deny the existence of voluntary movements to the bird—an extreme position—we are landed in physiological difficulties, inasmuch as it has been assumed by nearly all physiologists that the cortex is essential to voluntary movements. The case of the bird seems to me to show that we have much to learn as to the nervous mechanism of voluntary movements, notwithstanding all the investigation that has been given to this subject.

CONCLUSIONS.

In the dog and the cat there is a period extending from birth to about the time of the opening of the eyes characterized by reflex movements, the sway of instincts and the absence of intelligence. During this time the cerebral cortex is inexcitable by electrical stimulation, so that the psychic condition during the blind period is correlated with an undeveloped state of the motor centres of the cortex of the cerebrum. The advance in movements, first of the limbs and later of the head and face parts, together with the psychic progress associated with this is correlated with the rapid development of the cortical centres for the limbs in the first instance, and later for the head and face in the period immediately following the blind stage.

This is more rapid and more pronounced in the cat than in the dog, and is correlated with the greater control in the cat over the fore-limbs and with certain physiological and psychic developments characteristic of the cat.

Similar conclusions apply to the rabbit, except that the difference in the rapidity of development of head and face movements is correlated with an earlier organization of the corresponding cortical centres, and that there is a greater difference between the fore-limb and the hind-limb, with all of which there are special psychic correlations bound up with certain peculiarities of the rabbit's modes of life.

The vast difference in physiological and psychic development of the cavy at birth is correlated with the presence of cortical cerebral centres readily excited by artificial stimuli, centres which in a few days reach a practically perfect state of development.

The psychic manifestations of the pigeon and the fowl have not the same sort of cerebral cortical correlates as the animals referred to above.